SCIENCE

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CONTENTS:

Science and Culture: CHARLES E. BESSEY.....121
The Humanistic Element in Science: HENRY S. CARHART.....124
The Teaching of Beginning Chemistry: PAUL C. FREER.....130
Current Notes on Anthropology:—
Myths of the Northwest Coasts; The Story of 'Number Nip:' D. G. BRINTON.....135
Current Notes on Meteorology:—
Australian Meteorology; International Cloud Atlas; Meteorological Work at Batavia; Weather Map of the St. Louis Tornado: R. DEC. WARD.....136
Notes on Agriculture and Horticulture:—
Potato Culture; Hastening Maturity of Potatoes; Crimson Clover Good for Potatoes; Potash for Potatoes; Scab and Internal Brown Rot; Early and Late Potato Blights; Variety Testing of Potatoes; Government Farmers' Bulletin upon Potatoes: BYRON D. HALSTED.....137
Scientific Notes and News:—
Sir Joseph Prestwich; 'A New Factor in Evolution;' General.....138
University and Educational News:—
The Future of American Colleges and Universities; General.....141
Discussion and Correspondence:—
The Teaching of Anatomy: THOMAS DWIGHT; *Is not this Country ripe enough to adopt the Metric System?:* F. H. STORER.....142
Scientific Literature:—
Merriam's Preliminary Synopsis of American Bears: J. A. A. *Hatschek and Cori's Zootomie:* HENRY F. NACHTRIEB.....145
Scientific Journals:—
The Physical Review.....147
Societies and Academies:—
North Carolina Section of the American Chemical Society.....148
New Books.....148

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*SCIENCE AND CULTURE.**

IT is with peculiar pleasure that I stand before this new department of Natural Science Instruction, and I deem it a great honor that you have asked me to preside over its deliberations. It is an important sign of the times that such a department as this should have been organized by the scientific men of the country. It is significant of a broader view of the work of scientific men that we find so many here to-day to take part in the first meeting of a department which has for its object the discussion of questions pertaining to the teaching of science. I am assured that the movement which culminates in our gathering today is timely, and that it is but the visible expression of the feeling which has been steadily growing among scientific workers that the time is near at hand for a restatement as to the place of science in the education of a man. I congratulate you that you are among those who are to take part in this movement, and I trust that great good will result from your efforts.

With your permission, I wish now to bring before you, at the opening of this department, a few suggestions which may serve to give direction to your work.

It is not so long ago but that many of us have personal knowledge of the insignifi-

* Delivered before the Dept. Nat. Sci. Instruction N. E. A., Buffalo, July 10, 1896, by the President, Charles E. Bessey.

Large Scale Maps as Geographical Illustrations: By W. M. Davis. The value of maps in geographic study has long been recognized, but it has not always been so well stated as in the present paper. Prof. Davis maintains that their study endows the observer with a power that could not even be gained by field work without their aid, except by spending a long time on the ground, and that work based on good maps is as truly scientific as Loomis's famous studies. He proceeds to describe a number of foreign maps which are better than the average American maps, and have proved to be of especial help in his own teaching. He also gives information where these maps can be bought, the price and the results of experience as to the best way to display and use them. D. P. N.

THE MONIST.—JULY.

In an article on *Terminology*, Prof. Rudolf Eucken, of Jena, broadly sketches the characteristic biographical features and vicisitudes of scientific and philosophical terms, giving concrete examples in enforcement of his views, and pointing out the immense advantages to be derived from the systematic prosecution of this study. In his plan of a colossal and exhaustive thesaurus of scientific and philosophical terms he characterizes the realization of the same as a task eminently worthy of American scholarship, wealth and enterprise.

Prof. Fr. Jodl, recently called to a chair of philosophy in Vienna, critically examines, in his article on *Causality*, the views of David Hume, which he regards as having dominated all modern inquiry on this subject, including Kant and the Kantians and the majority of professional scientists. He then discovers the origin of the notion of causality in our feeling of personal effort and of our personal action upon the external world, and considers it to have found its rigorous justification in the modern view of the transformation of energy and matter. His article contains much psychological analysis.

The second part of the series on *Science and Faith* is by Dr. Paul Topinard, entitled *Introduction to Man as a Member of Society.* Dr. Topinard discusses his subject under two heads: (I.) Preliminary Biological Data; and (II.) The Animal Family; which are to be followed by another article on Animal Societies. He follows here the origin and course of development of the solidarity of the organism and of its representative ego, as also the origin and development, in all its aspects, of the *animal family*, which he regards as the outward terminal phase of the process of the reproduction of the species—a result which has been shaped to this end by the exigencies of evolution. The rise of the social instincts is also considered in this paper, which is exhaustive and contains the results of new inquiries by Topinard.

The *Holiness of Instinct*, the title of the leading article, by Dr. Woods Hutchinson, is a plea for the reinstatement of our natural instincts as unerring criteria of conduct, and also a literary apotheosis of the beauty of life.

The article by the editor, Dr. Paul Carus, on *The Problem of Good and Evil*, opposes the idea of a merely subjective existence of evil, which he regards as a positive, objective aspect of life, and concludes with a discussion of the God idea and with a sketch of the significance of the devil in history.

The number concludes with the usual Literary Correspondence. Among the Book Reviews are critical notices of Ostwald's pamphlet on *Scientific Materialism*, Helmholtz's *Researches in Mathematics and Mechanics*, Grassman's *Ausdehnungslehre*, and Henry Clarke Warren's *Buddhism.*

NEW BOOKS.

U. S. Geological Survey; Fifteenth Annual Report, 1893–94. J. W. Powell. Pp. xiv+755. *Sixteenth Annual Report*, Part II. Papers of an Economic Character, Pp. 598, Part III. Mineral Resources of the United States Metallic Products, Pp. 646, Part IV. Mineral Resources of the United States, Non-Metallic Products, Pp. 735. Charles D. Walcott. Washington, Government Printing Office. 1895.

The Scenery of Switzerland. Sir John Lubbock. New York and London, The Macmillan Co. Pp. xxix+371. $1.50.

Home and School Atlas. Alex. Everett Frye. Boston and London, Ginn & Co. 1896. Plates X. Pp. 48.

cant place accorded to natural science in the schools from the primary grades to the college. Afterwards there came a period of conflict between the advocates of science, on the one hand, and of the old culture-studies, on the other. In the controversy much was said which should have remained unsaid, and many arguments were brought forward which have long since been abandoned by both sides.

Thus, in urging the introduction of science into the schools, much was said regarding its usefulness, as in farming, in manufacturing and in commerce. The usefulness of science in everyday life was brought forward as one of the strongest arguments for its introduction in the course of study in school and college. This was so emphasized as to lead some to hold forth the money-getting value of science as contrasted with the culture-value of the older studies. Thus there arose in the popular mind the notion that while science is more 'practical,' and while it may fit a man to earn a livelihood, it is lacking in culture-value. The notion has been fostered by the fact that in the building of technical schools science has been given a large place. In fact, these schools are very commonly called scientific schools and colleges. When the educational world, during the latter half of the present century, saw the rise of engineering and mechanical schools, in which chemistry and physics were given great prominence; of agricultural colleges, in which botany, zoology and chemistry occupied the greater part of the student's time; of schools of horticulture, schools of dairying, sugar schools, etc., in all of which one or more of the great modern sciences occupy prominent place, what wonder that science seemed to be merely a servant to minister to man's material interests! What wonder, too, that some men, dazzled and bewildered by the splendid achievements of science in many fields of human industry, became materialistic and set up science as their educational goddess! In this period we heard much of the 'new education,' and too often by this term was meant little more than is included in mere trade schools. The 'new education,' while ostensibly an education in which science replaced the language and literature of the older curriculum, very commonly included merely such sciences as were of immediate use in a particular industry, and too often only those portions of these selected sciences which were most directly 'practical.' To make the matter worse, the graduates of schools with such a curriculum were called Bachelors of Science. What wonder that some men looked askance at scientific courses of study! What wonder that college men, who had been accustomed to think of the culture-value rather than the money-value of the studies in the college curriculum should hold aloof from close association with such science!

Against such merely utilitarian views as to the place of science there have been strong protests during all this period of educational unrest, but these have been little heeded. Gradually, however, with the increased introduction of science-study in the schools and colleges, doubts have arisen as to the soundness of the utilitarian view. The question is often asked whether science is 'useful' merely in the lower sense of contributing to man's material advancement. Our thoughtful students and teachers are asking whether science may not be pursued with profit by those who will not 'apply' it in some industrial pursuit. May a man profitably give prolonged attention to chemistry who does not propose to be a manufacturing chemist, an assayer or a maker of drugs? Is it a profitable use of the time of the college student to give years of study to the lower forms of vegetation, unless he hopes to become the botanist of some experiment station, or

expert bacteriologist of a cheese factory or brewery? In other words is there a culture-value in these studies? May a man profitably pursue science for its culture-value, as one pursues the classics, literature, history and mathematics? Is a man made a better man, not merely a more efficient money-making machine, by the study of science? These questions are now being asked by teachers and students, and it is to help answer these that this department has been organized.

The making of a man to-day is a complex undertaking. Life is too short and knowledge too vast for us to think of furnishing a man with mere knowledge. No man can hope to master all knowledge. No man can hope to master all the details involved in the life of the community in which he lives, much less those of the civilized world. In the making of a man in primitive communities, little more was necessary than skill in hunting and fighting, with a few arts, all of which could be easily acquired by a few years of practice under the guidance of his elders. To-day in the making of a man we must develop the almost primitive child, with his limited horizon of knowledge and philosophy, into an alert, quick, accurate being, able to comprehend and classify the multitudes of facts, and to grasp and solve the many problems with which modern life is filled. We realize to-day that in making a man we must train him. We can no longer hope to acquaint him with all facts, but we may prepare him to classify and arrange them. And here perhaps is the best test of good training, of what we call culture; it is the ability to accurately classify. That culture is best which so prepares a man that whatever fact presents itself to him he will be able to arrange it accurately with reference to others. This ability to classify facts is of far more importance than the mere acquaintance with facts, however extended the latter may be.

May science help in such training as this? Can it contribute to culture? Must we still rely for culture upon the old studies only, or may we look to science for help? The answer to these inquiries should not be hard to give. In spite of the fact that science has been so badly treated, in spite of the fact that for so long its culture-value has been little esteemed, I venture to say that when properly presented it will stand second to no other subject.

In the first place, it must be clearly understood that nothing here said implies the substitution of the culture given by science-study for that given by the classics, literature, history, mathematics, etc. We cannot spare that culture from modern life. But we need in addition the special culture given by science. The culture given by science must be supplementary to, and not substituted for, the culture with which we have long been familiar.

Let the teacher of science make use of it as a means of culture for students. Let teachers set forth the culture-value of science study. Let us hear less in the schools of the practical value of science. Let us emphasize its vastly greater importance in the making of men. We are already familiar with some of the direct culture results; thus we know that through science-study quickness and accuracy of observation are developed, and both eye and hand are trained to be the ready servants of the alert mind. In the pursuit of the higher lines of science, the mind is trained to accurate generalization from secure data and to an indefinite suspension of judgment in the absence of sufficient evidence. The proper pursuit of science should develop a judicial state of mind toward all problems.

Indirectly the pursuit of science leads to a higher appreciation of Nature. As a man understands the meaning of the natural world his appreciation of its beauty and

grandeur is increased. He is then led to entertain broader views of Nature and to see more clearly the relations of part to part. Finally he is led to a proper appreciation of his place in nature; possibly he is humbled by the certainty of his individual insignificance in the vast organism, but he is strengthened by the equal certainty that in his race he is the inheritor of all that makes for progress and advancement.

Men of this department of Natural Science Instruction, shall we not make of science a help to higher culture, rather than an aid to more material success? Let us give it wings, so that it may carry our pupils above mere earthly things, and not doom it to do no more than turn our spindles, haul our goods and coin our money. While we rejoice in these material achievements of science, let us bear in mind that these are not of supreme importance. When we stand by the mighty Niagara we realize that it has an infinitely higher significance for man than the mere turning of wheels. Just as the solemn flood of water speaks to and stirs man's deeper thoughts, and makes him forget the wheel-turning power of the rushing torrent, so the profound contemplation of nature through enlightened and untrammeled science leads him away from sordid things up to the higher planes of thought and experience.

Chas. E. Bessey.

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*THE HUMANISTIC ELEMENT IN SCIENCE.**

The time has happily passed when the rival supporters of literary studies on the one hand and of scientific studies on the other slept on their arms or engaged in open combat. Both sides were intent on victory, with no disposition to give quarter or to concede that the truth might not all be on one side. But when opponents have come to know each other better they not infrequently abide by at least a tacit agreement to live as friends. We have now arrived at such a stage in educational history and practice. An occasional note of discord still comes from the few who refuse to be reconstructed; but the prominent figures in the old conflict are fast passing over to the majority, and the new generation is born with a more pacific spirit. The pursuits of peace are more liberalizing than the devastations of war. Hence the origin at first of a spirit of toleration, and then of equality and fraternity. It is now time to inquire about a common ancestry and community of aims and interests. The spirit of the times does not sanction narrow bigotry or unseemly dissension. Educational intolerance is now as much an anachronism as religious intolerance or martyrdom for conscience. It has come to be recognized that no one system of theology contains all the truth, and no one branch of human learning is the sole instrument of culture, nor does it possess the exclusive capacity of imparting power.

At the time of the revival of learning in the Middle Ages the apostles of the Renaissance, who introduced the study of classical literature, were called humanists. Hence humanism has often been called 'the culture derived from classical training.' But more broadly, humanism is a system of thought in which the human element or interest predominates. The humanities therefore include much more than classical language and literature. They stand for philology, poetry, rhetoric, grammar and archæology, as well as for the Greek and Roman classics. Philological studies, says G. P. Marsh, "were called *literæ humaniores*, the humanities, by way of opposition to the *literæ divinæ*, or divinity, the two studies, philology and theology, then completing the circle of scholastic knowledge, which, at the period of the introduction of the phrase, scarcely included any branch of

*Read at the Buffalo Meeting of the N. E. A., July 9, 1896.

physical science." The humanities were not so named because of their peculiar value in producing culture, nor because of the human interests which they fostered, but because they were human or secular in their nature, as contrasted with the theological or divine.

Ever since the revival of learning, philology and polite literature have been justly held in high esteem as instruments of culture and as 'the literature of power.' Generation after generation of English scholars and statesmen have received their intellectual training largely by means of mathematics and the classical languages. In modern times there have been added to these, subsequent to University residence, the acquisition of modern tongues and extensive foreign travel. In America the classics have furnished the major part of a liberal training to many successive classes of students. It is only within the past twenty-five years that science has come to form any considerable part of the curriculum of American colleges. It is not my purpose to detract in any way from the utility and value of literature, philology, and philosophy as important components of a liberal education, but rather to show what the study of science has in common with the humanities as liberally interpreted by the broadest scholars. A high estimate has rightly been put upon the study of the humanities by the most prominent educators, and it is not necessary to undervalue their judgment for the purpose of advancing the cause of science. Whatever antipathy or opposition science has encountered has had its origin either in prejudice or in a lack of understanding of the aims, the nature and the content of any connected body of science. It is perhaps folly to try to remove the former, but a more refreshing task to point out what human interests are involved in the pursuit of science, and to what higher ministry to man's intellectual and ethical needs it has been applied.

It may be well at the outset to clear away a misconception relating to the objects in view in scientific study and investigation. It is a gross libel on scientific men to assert that the chief end aimed at in the pursuit of science and the claims most strongly urged in advocacy of its cultivation are narrowly utilitarian or intensely practical. If worldly success were the only reward awaiting the scientific investigator, but few branches of science would be fortunate enough to find their votaries. The taste for scientific research is a passion which finds its gratification in the truth it seeks. It can never be satisfied to con over the lessons of the past alone, but it restlessly pushes on into new chapters. The true scientific man recognizes the immense value of literary and linguistic study; he is also aware of the fact that the human intellect is many-sided and has numerous aptitudes. To be broadly developed, to have liberal sympathies, and to acquire the power to be master of circumtances, the educated man of to-day must know not only language and literature and history and philosophy; but he must have knowledge of his environment, of the physical laws under which he lives, of the varied life about him, of the earth which he inhabits, and of the heavens spread out in magnificent panorama above him.

Languages are considered to be the humanistic studies *par excellence* because they are the product of human endeavor, the outgrowth of human thought, the chief exponent and index of evolution in the human mind. All language is therefore entitled to be included in the humanities. But all languages are not of equal interest and value. They are not all equally developed products, not all equally differentiated flowers of the human intellect. The greatest interest attaches to the language of

those people who have attained to the highest civilization; whose art, architecture, industries, literature and learning have reached the highest development; whose works, in short, possess the highest finish as the expression of human thought.

An important distinction may be made among the subjects belonging in the narrower sense to the humanities. Language in its structure may be regarded as the involuntary product of human activity, the result of the unconscious struggle of the mind, its reaction against the environment, with the result of a definite attainment not aimed at. The results are not fortuitous, because all activity is under law. Whether the effort is conscious or unconscious, the result anticipated or unexpected, it must issue in accordance with the laws controlling human action. On the other hand, art, architecture and poetry are the conscious products of thought. They are the results of struggles after definite and well conceived ends. They are the issue of an inner impulsion toward an ideal attainment. They are not so much the finality of collective effort as the offspring of individual genius. The written language, the canvas and colors, the quarried marble and granite, are the materials with which art works and out of which it constructs a poem, a painting, a statue, or a temple. They are compelled by poetic and artistic genius to shadow forth the ideals existing in the mind of the poet and the artist. The pigments and the marble are not art. It is the artistic use of language, of canvas and of marble that require the skill of the master. Then too the pen of the poet, the brush of the painter, and the chisel of the sculptor touch their highest point when they delineate that which is truest in life and nature, softened with ideality and ennobled by aspiration.

Now what characteristics has science that ally it to literature and art? What have they in common which entitles science to be treated as one of the humanities?

In the first place the materials which science uses are her own. It is this fact which differentiates science from other branches of learning. But given the materials, the operations of the human mind in working on them are kindred in character and similar in result to those of the same order of intellect elsewhere. It is an unworthy conception of science that makes it consist in the collection of facts about the material world or even the higher animal life. These materials, it is true, must be collected, just as the pigments must be ground and the marble and granite must be quarried. But he who stops with the collection of facts is doing the lowest order of work in science. He contributes to the final result, but it requires genius to clear away the rubbish and to construct the temple of science out of the scattered materials. Or better still, the genius in science does not merely hew and shape and color, but he brings together the *disjuncta membra* formed by the hand of the Almighty, and reconstructs a beautiful body fit for the Creator to look upon. The most important element in science is the human element, that which vivifies the dead facts, fuses them with the fire of imagination, beautifies with the fine finish of ideality, and constructs an articulated system which must conform to the truth. Science is then in a very large sense a product of human thought, the result of human endeavor. A body of correlated scientific truth can hardly be studied apart from the personality of the names inseparably linked with it. It is scarcely less a human interest which draws us to it than that which attaches to language as the instrument of human expression. Indeed the former has the added attraction of distinct personalities. It is the personality of a few master minds working with creative ability, impressing their

own thought upon science, and marshalling facts in great divisions which embody their ideas of the order and dependencies of nature.

It is no new thought that scientific study makes a draft upon the imagination. This aspect of science allies it to art and literature. Music and mathematics have not infrequently been congeners in the same gifted genius, and mathematics is becoming an indispensable adjunct to every branch of science. Maxwell, perhaps the greatest modern physicist, often indulged in poetic composition, and his poetry was of no mean order. It may be readily granted that the scientific imagination is cultivated and strengthened by exercise in the related realm of poetry. The intricate and fascinating subject of electricity is greatly indebted to the imaginative faculty of the great discoverers in this field. It is an unfruitful science that has not been enriched by the scientific imagination.

In another respect science fosters human and ethical interests. It compels the restless struggle after ideals. It holds up an ideal condition which is the goal of its ambition, the one thing which it must attain before it can rest content. Hence the scientific worker studies sources of error and seeks to eliminate them. By repeated attacks he approaches nearer and nearer to the citadel which he tries to capture. And after all is done he recognizes that the object of his endeavor has not been fully attained. It is much like the chase after the foot of the rainbow, which ever moves onward as it is pursued. Says Huxley: "Men are said to be partial judges of themselves. * * * Life seems terribly foreshortened as they look back, and the mountain they set themselves to climb in youth turns out to be a mere spur of immeasurably higher ranges when with failing breath they reach the top." But it is infinitely better to have reached the top of a spur even than never to have begun the ascent. The whole world has been called to a broader outlook and a grander vision by those who have reached the spurs and higher ranges. Their effort after ideals ennobles and humbles. It chastens while it subdues.

In some respects science is more humanistic than the humanities. Here and there ancient literature enforces the conception of the reign of law. It presents the human captive vainly prolonging the struggle to escape it. Tantalus-like, the unattainable ever eludes the seeker. Prometheus bound is a fit symbol of circumscribed humanity. The same thought, which has always impressed itself upon the race and worn itself deep into human experience, is enforced in Holy Writ: "If I take the wings of the morning, and dwell in the uttermost parts of the sea; even there shall thy hand lead and thy right hand hold me."

Now science illustrates and emphasizes the reign of law. It has cleared away the mystical, the fortuituous, the anthropological, and has given us instead the orderly and progressive sequences of natural phenomena. It has in no way weakened the necessity felt for a First Cause, but it presents the activity of that Cause under a new and more rational aspect. It presents a Creator who sees the end from the beginning, who does not need to hold the world in leash or drive it with a goad, but who endowed matter with certain capabilities and infused into it divine energy, so that it can run its ceaseless changes down the grooves of time. Science has replaced a world of humanistic divinities by a world of energy and law. Instead of the caprice of classical gods and goddesses, it has supplied a physical organism devised and elaborated by infinite wisdom. Man has therefore learned to order his physical life so as to conform to the laws of the physical world, or if he elects to transgress those laws he does not expect the interposition

of humanistic divinities to effect his escape. So impressed is the human mind by the reign of law in the physical world that it has carried this conception over into the spiritual. 'Natural law in the spiritual world' is an obvious sequence of natural law in the physical world. It is therefore an intensely human interest that impels to the study of the reign of law.

Every great branch of learning has been adorned with the names of eminent scholars and discoverers. When we bear in mind that the arts and sciences are the product of directed, conscious human effort, and that it is the lot of but few to be endowed with the intellectual insight, the native sagacity, the penetrating perception to push far beyond their fellows, we are not surprised at the smallness of the number of luminous names that shine on the rolls of honor, or that go down to succeeding generations as the great discoverers. The human interest in these names, differentiated from all others by their powers and their contributions to the progress of the world, is equally intense whether they belong to art or architecture, to literature or science. To these men it has been given to delight the soul with beauty, to penetrate the unknown, to enlarge the boundaries of human knowledge, and to gather up the tangled threads of thought and weave them into a tapestry of beautiful design. Each department of creative art or of learning is justly proud of the distinguished names associated with it. They all inspire the same human interest and are characterized by the same passionate devotion. Galileo, persecuted and condemned for his scientific writings, is still a vivid figure, a living personage in history; and we look with reverence upon the old bronze lamp or candelabra, swinging on its long suspending rope in the Duomo at Pisa, as it swung centuries ago when Galileo watched it and discovered the isochronism of its pendular motions. Old Copernicus, turning over with death-stricken hands the first copy of his book on the solar system, which he dared not publish sooner, is a figure to excite at the same time sympathy and indignation. The genius of Michael Angelo still presides over the art and architecture of Rome, and Raphael will forever stand beside the glowing canvas of the Sistine Madonna, which burns itself into the soul of every beholder. One almost expects to see Scott standing within the deep shadows of Melrose Abbey by moonlight, or strolling with his faithful hounds in the woods about Abbotsford. Alloway Kirk and the Brig o'Doon are still visited by the strange creations of the busy brain of Burns. How sweetly the chimes of Holy Trinity Church ring out over the hills about Stratford-on-Avon on a quiet evening! Green are the fields and quiet the cottagers along the cleanly lanes and alleys where the great poet was born. In the spacious chimney corner of the Hathaway cottage linger the shades of Ann Hathaway and William Shakespeare. It is hard to believe that for 300 years the ashes of Shakespeare have reposed beneath the slab in Holy Trinity, guarded by the famous couplet,

> "Blest be the man that spares these stones
> And curst be he that moves my bones."

The scientific traveller in London turns his steps toward the Royal Institution in Albermarle street, where the noble Faraday worked and achieved immortal renown. There are the coils and magnets and other appliances which his own hands fashioned; and Faraday himself is everywhere present there. How powerful still is the memory of our own Joseph Henry at Princeton and Washington! Though he be dead, his works do follow him.

Prof. Butler said in his address at Denver: "We must enlarge our conception of the humanities, for humanity is broader and deeper than we have hitherto suspected.

It touches the universe at many more points than one; and, properly interpreted, the study of nature may be classed among the humanities as truly as the study of language itself. This conclusion, which would welcome science with open arms into the school and utilize its opportunities and advantages at every stage of education, does not mean that all studies are of equal educational value or that they are naturally and indifferently interchangeable, as are the parts of some machines. It means rather that the study of nature is entitled to recognition on grounds similar to those put forward for the study of literature of art, and of history." This position concedes the claim which I am now urging. It is an ancient chapter in educational history that places the humanities in one grand division and the sciences in another, without mutual relations or common aims and interests. The relative value of these subjects as educational material I am not now disposed to discuss, passing it with the remark that the order of excellence laid down will depend upon the standard of values assumed and the point of view of the writer.

It will not be inappropriate to make special reference to the study of physics in connection with the subject of this address. No one of the sciences is associated with a longer list of splendid names; none appeals more strongly to that characteristic of the human mind which searches into the causes of phenomena; none is more capable of serving directly human needs and of advancing the material interests of society.

It is almost the universal judgment that physics is a fundamental subject, and more than any other is essential to the pursuit of other branches of science. In its historical development it is no less ancient and honorable than chemistry, while in recent times the proof that it has lost none of its vigor lies in the splendid discoveries that are almost unrivaled in any other department of scientific investigation.

It is therefore justifiable to urge that physics be made an essential part of every course of study in secondary schools, and that the place and time devoted to it correspond to its importance. It is not enough that physics be admitted to all secondary schools, but that it should not be there in a secondary place. It should be placed on an equal footing with the most favored subjects. It seeks no preferences, but is strenuous that no special bounties be extended to other branches. Whether it be considered from the point of view of its educational value, of its splendid achievements and its service to civilization, or of the interest that it awakens in the unfolding mind of the inquiring student, it should form as essential a part of every course of study as mathematics or history or language. First of all, a student should know his own language; it does not admit of question that he should also know the historical development of his own country; he should in addition be familiar with the fundamental physical principles and concepts which are as closely interwoven with his life and well-being as are his language and the history of the land in which he lives.

If now the pursuit of this noble science is to serve the human and ethical interests which we are contemplating, it is essential that its serious study be entered upon at the right period in the education of the pupil. It is very properly pointed out by Mr. Gage in the report of the Conference of Ten on Physics and Chemistry that "Physics requires the largest knowledge of mathematics that the secondary school affords, and the difficulty of this study demands the greatest maturity of mind." What interest can be served by placing it in the first year of the high school, except

its subordination to more favored branches, it is quite impossible to understand. The Conference of Ten recommended "That physics be pursued the last year of the high school course." That recommendation meets the enthusiastic approval of every physics teacher whose experience is worth considering. The exigencies of the school programme sometimes require that physics be crowded down into the third year, but the instructor in this subject should never cease to protest against any further lowering of the standard by its relegation to the second year. When only a single year is sought for a subject of such transcendent importance, the studies that are crowded to the front for from three to six years should be compelled, in all fairness and reason, to give way, if necessary, at the point where the physics properly belongs. The pupil will then be provided with the requisite knowledge of geometry so essential to the intelligent study of physics, and may be presumed to have that maturity of mind which will enable him to profit by the study.

The limits of this paper do not permit me to enlarge on the method to be pursued in teaching physics. It must suffice to say that the student in the elements needs a text-book of principles for the purpose of securing accuracy and to enable him to dwell long enough on any portion to comprehend it. To the didactic work of the class room should be added the method of the laboratory. Practical work acts like a mordant to fix the color which may otherwise be evanescent. It is the testing machine to determine the strength and toughness of intellectual fibre. It furnishes a scale by which to evaluate acquisitions. It is the method of original investigation applied to the student; he will not discover any new laws of nature, but he will discover his own ignorance and limitations.

Henry S. Carhart.

*THE TEACHING OF BEGINNING CHEMISTRY.**

The momentous changes which have been brought about in chemical science within the past two decades are too often lost sight of in teaching the elements of the subject. It is easier to go in the old way, the habit of descriptive chemistry, founded primarily on the atomic hypothesis, is too well established to be suddenly uprooted, and, as a consequence, in America we can see but little progress toward a more rational and scientific means of beginning the study. The reason for this unsatisfactory condition is most probably to be found in the history of the development of science during the present century. Gay-Lussac, Dalton, Berzelius, Davy, Faraday, and the other lesser lights who appeared upon the chemical firmament between the years of 1800 and 1826, were completely engrossed with the discovery of new elements, the determination of chemical equivalents and the relationships between these latter quantities and the atomic weights. It was then that our system of chemical notation originated, and for this, even if his name were not inseparably connected with other lines of advance, we owe a lasting debt of gratitude to Berzelius. Naturally at this time, methods of analysis in inorganic chemistry, both qualitative and quantitative, assumed the greatest importance, for where the composition of so many new minerals remained to be ascertained, and when in each a possible new element might be discovered, such work must necessarily claim the attention of the foremost investigators. Scarcely an appeal was made to turn the science into broader channels, the material side was uppermost, the statics of chemistry was being investigated, and there was no time to think of the nature of chemical changes from any standpoint other than that of the transposition of matter. The

* Delivered before the Dept. Nat. Sci. Instruction, N. E. A., Buffalo, July 10, 1896.

voice of the great Berthollet was, it is true, raised in a demand for the study of the physical aspect of chemical change, while Avogadro explained the meaning of Gay-Lussac's and Dalton's discoveries of the simple relationships between combining gas volumes, but both were unheeded, for the chemical field was not ripe for such development. During the latter part of the life of Berzelius we find such investigators as Wöhler, Liebig and Dumas busily engaged in building a new edifice of structural organic chemistry, and at the same time the tendency showed itself to unduly emphasize the importance of chemical symbols, for the theory of compound radicles with its numerous variations, held most men in its grasp. Chemical bodies were classified according to arbitrarily constructed formulæ, regardless oftentimes of obvious family relationships; theory began to outrank exact observation; and, even with so careful an experimenter as Berzelius, chemical formulation began to distort and replace ascertained facts. This chaos, produced by the clashing of minds, all equally qualified to dictate in the chemical field, was further heightened by the lack of any reliable scientific basis for the determination of atomic weights; there were almost as many systems as there were chemists. It was only after 1850, when Cannizzaro successfully revised Avogadro's hypothesis, when the laws of thermodynamics were established and when the impulse toward a logical system of atomic weights was given, that some advance toward order was made. From this time on, owing to the labors of Kolbe, Williamson, Strecker, Gerhardt, Laurent and finally Kekule, our present views of valence and structural chemistry began to take the place of former confusion. With the advent of the definite theory of quadrivalence of carbon, at first advanced by Kekule simply as a means of classification, a basis for united action was given which was eagerly seized on by all of the workers in the chemical field. Never before had so simple a theory been adopted, and never before had one appeared which so heartily met with the approval of most men. So easily comprehended, indeed, were these views that, as a logical consequence, chemists were carried too far in their enthusiasm; if the tetravalence of carbon was established, why was not a constant valence true of all other elements? Acting on the impulse, the classification into monads, diads and triads, etc., was made, often in utter disregard of easily observed facts. Theories were once more confused with the facts from which they were deduced, and an arbitrary method of chemical teaching, far removed from the basis on which physics rested, was inaugurated. The chemical symbol and chemical equation were given a rank and place far above their merits; and, as a consequence, the scientific axiom that all theoretical deductions must be founded upon carefully observed facts was too frequently lost sight of. Even Mendelejeff and Lothar Meyer, in their Development of Newland's Periodic System, were often tempted to force dogmatic classification upon the chemical world. This tendency in chemical teaching has continued to the present day, and along with it we still have the undue emphasis laid upon analytical chemistry, a remnant of Berzelius's time, although the chemical field has been so widened that many other branches of the science have far outgrown the latter in relative importance.

Taking heed of the errors of the past, it is time to bring the teaching of chemistry to a purely scientific basis of experimental observation, to omit theoretical deductions, especially the atomic theory, until such a time as the pupil has at his disposal sufficient material to give it a definite basis to rest upon.

There are two laws which are fundamen-

tal throughout chemistry, the law of definite and the law of multiple proportions. No matter whether or not we hold to the atomic theory, these would remain unalterable and by their existence would inevitably force the science to be a quantitative one. By leaving this basis, or ignoring it, while still keeping the atomic hypothesis in sight, even great chemists have been led to adopt the most impossible theories and to distort the most carefully established facts, as the history of Prout's hypothesis abundantly demonstrates. But, if the foundations of chemistry are quantitative, why not begin the study of it in such a way that this aspect is thoroughly and permanently brought out to the attention of the student? The difficulties in the way are not great; the necessary equipment for the work does not add a large outlay to those expenditures which all properly provided laboratories already have to meet, and in the majority of cases experiments for beginners can be altered from the qualitative to the quantitative ones by the simple graduation of a glass tube. The quantitative neutralization of acids by bases and *vice versa*, easily carried out with accurate results, is especially useful, combining, as it does, both the laws of definite and multiple proportions and the most striking chemical characteristics of two important classes of compounds.

The study of the combining volumes of gases is also simple and necessary as leading up to subsequent important theoretical considerations; only by following a course of accurate work can a proper basis be secured for future generalizations.

The atomic theory has no place in the beginning of the study of chemistry. The reactions which students encounter during the first period are as easily understood without it as with it. Its early use is confusing and pernicious, giving, as it does, a visionary and immaterial basis for the science, which is too apt to cling to the pupil throughout his subsequent course. Our belief in this theory has been brought about by the convergence of a number of lines of investigation which have made use of facts discovered both in physics and in chemistry, and it should be dealt with in this way. If we use it in any other we are bringing ourselves back to the scientific standpoint of Aristotle, whose deductions were subjective and not objective.

Chemical formulæ are, of course, in their present meaning, founded on the atomic theory, and therefore are to be excluded until after the proper work has brought about their logical development. It is not, however, inexpedient to introduce a few symbols which represent not atoms, but equivalent weights which are so related as to be referred to one gram of hydrogen as a unit, for by this means an advantageous conciseness of expression can be obtained. So, to use a concrete example, it can readily be demonstrated that, by the action of certain metals on acids, a definite quantity of hydrogen is substituted by a given weight of each metal, and, if in such an experiment we select the unit weight of hydrogen as a basis of calculation, we have a means at hand of ascertaining the reacting quantities of the substances in question. These relationships are further exemplified by the experiments on neutralization, so that, finally, a few of the simple reactions can be expressed by a system of notation which is founded only on observed facts. In this way a basis is obtained for further enlargement and explanation when the time comes to introduce theoretical deductions, and thus the pupil can be brought to understand the scientific means by which our present system has been brought about. It is too often the case that students who have even had a somewhat extended chemical instruction are only able to present their knowledge in a language of symbols, of the fundamental meaning of which they

have no conception. They are chemically helpless if they cannot have pencil and paper and are not allowed to express themselves in the form of chemical equations. It must be confessed that the teachers are more responsible for this state of affairs than the pupils, because in many text-books and laboratory manuals we find, possibly for the sake of a mistaken idea of saving printer's ink and paper, directions, paragraph and chapter headings given in the shape of chemical formulæ to a beginner in the science. The current language was constructed for chemists as well as for other mortals, and I see no reason why we should not express ourselves in its terms. The pupil should be able to tell us what he knows, and he should not be wedded to his writing materials.

One phase of chemical investigation has made such enormous strides of late years that it can no longer be ignored even by beginners in the science. I refer to so-called physical chemistry. From the start the teacher and pupil must recognize that there are two enduring things in the universe—matter and energy—and that but half of the tale has been told, when in studying a chemical change, only the former has been considered. Of course, it is not possible in all cases to consider the latter; none of us are as yet able to do that, no matter how great our experience or how much we have worked in this line; but in the simple reactions which are encountered at the beginning of the course the question of energy changes can be dwelt upon as clearly as the others. Such a line of work requires a certain knowledge of physics, and "as chemistry is a branch of the study of the relations of matter and energy it should be preceded by the more general aspect of this subject which is undertaken by physics. Obviously, owing to the close connection between chemistry and physics it will frequently be required to more clearly outline physical topics in chemical work, and to enable the teacher to make such outlines, a preliminary general knowledge of physics is necessary."* Another topic in physics which must necessarily be introduced before the atomic hypothesis is taken up, is the kinetic gas theory, for a comprehension of which some knowledge of elementary energetics is necessary. It is very easy to make the pupil learn the dogmatic statement that 'in equal volumes of gases, under like conditions of temperature and pressure, there are equal numbers of molecules,' but to make him understand why this fundamental theory is accepted by the scientific world, and what is its bearing on our present system of atomic weights, requires careful reasoning and conscientious teaching, without which the dogma becomes as useless as any other empirical utterance. In short, I would have the pupil's preliminary work, both physical and chemical, so centered around observed facts that he will approach his theoretical conclusions with a mind free from bias, and so logically trained in the successive steps that he may enter upon his more difficult task in a condition to comprehend its full meaning and significance. It is desirable that he should feel the need of some such theory as the atomic theory, before the teacher shows him the way for its development.

Double decomposition and phenomena attendant upon it have lately come to be among the most important topics in physical chemistry. This subject must be introduced in an elementary course, but the present state of the science forbids that it shall be treated from an empirical standpoint in which the most important fact is the obtaining of a precipitate which can be made to serve the purpose of identifying

*Extract from a report made by a committee consisting of Messrs. Noyes, A. Smith and Freer at the conference of chemists of the Northwest at Chicago, January 2, 1896.

some chemical individual. These chemical separations are simply particular cases incidental to certain conditions obtainable in a series of general phenomena, and as such they should be treated. An elementary knowledge of chemical equilibrium, of dissociation in solution, of the separation of ions by the electric current and of the modern views of neutralization, is now as essential to the beginning of chemistry as any of the descriptive portions. Armed with such a knowledge, the pupil can approach many subsequent facts, which were formerly simply memorized, from a reasoning standpoint.

To render such a course of study as I have outlined successful, it is necessary only to take up but a few of the more common elements and compounds, doing the work thoroughly and conscientiously. Important chemical deductions are as well illustrated by a few widely distributed and simple substances, as by many. The time for the study of all of the elements and of their relations in the periodic system is not in the beginning. Such work can only be undertaken in a systematic spirit when the pupil has been taught to reason in the terms of the science. A mass of descriptive detail, no matter how well it is memorized, is not chemical science; the time is passed for that; we are not longer in the age of Berzelius. For the same reason I would leave the subject of valence for a later period. The reasons for its acceptance are many and complicated; they are the result of painstaking work, of much bitter strife and heartburnings, and are too intricate for the beginner. I have much more faith in the pupil who has been trained to accurate observation, who can logically connect what he has seen and who can tell what he knows, than in the one who, by a system of arbitrary instruction, can write down any number of chemical formulæ and equations, founded on a dogmatic and too early discussion of the theories of valence. Are not even the most brilliant investigators in the science in doubt as to its present position and as to its future development?

In conclusion I would like to answer the argument that I know will be brought against me. It will be said that while the outlined course is well adapted for those who wish to make a life study of chemistry, it can scarcely be applied to pupils who will never take any more chemical work than that given in an elementary course. It is absurd to suppose that an elementary course is intended to produce a chemist. The most that can be done is to give the beginner some knowledge of the fundamental principles of the science. Such being the case, how can we best give the pupil the mental discipline incidental to the scientific habit of thought, and at the same time put him in a position to go on with his work in chemistry, should he so elect? Surely not by taking incidental facts from the entire field, by introducing him to theories which he can not comprehend, and by burdening his memory with a mass of material which disgusts him with the science and leaves him helpless for future advancement. We must always take pains, in teaching beginners, to pick out that which is absolutely essential to their comprehension of the science as such, and even if we use only such materials we shall find that the allotted time is more than filled. We must not depart from our ideal of scientific truth to meet a demand which we recognize as not in the interests of the science. By failing to teach the pupil the true elements of chemistry, and by attempting to make the course, as it is termed, 'practical,' we are in reality doing the most impractical thing imaginable, not at all teaching the real science of chemistry, besides stunting the pupil's future scientific growth.

Above all, we should compel our students

to observe accurately and never to put their conclusions in their note books, until they can base such conclusions on what they have seen. I have known of teachers who require their students to balance large numbers of equations, outside of the laboratory and according to set rules, and thus entirely subvert the purpose of chemical notation, which is, at its best, but a short means of expressing observed chemical facts, and as such should only be used in the laboratory as a means of describing what the student has actually seen. The former course leads the beginner to the conclusion that chemical reactions must actually take place exactly as the equation demands; the latter teaches him to observe accurately and to express his observations in the terms of the science. Finally, I regard such work as this fitted only for advanced students; the chemical equation has but a small place in the beginning study of chemistry.

PAUL C. FREER.

CURRENT NOTES ON ANTHROPOLOGY.

MYTHS OF THE NORTHWEST COAST.

FOR some years Dr. Franz Boas has been collecting and publishing the myths and stories of the tribes of the northwest coast. In the last number of the *Zeitschrift für Ethnologie* for 1895 he sums up his theories of their development and extension. His conclusions are that the tribes there located not only borrowed from all parts of America, but drew largely for their material from the Old World also.

This conclusion from such an eminent authority will give considerable satisfaction to those who are on the hunt for traces of Asiatic culture in America. Dr. Boas reaches it by counting the number of 'elements' or incidents in a story, and then ascertaining how many of them reappear in a similar story told at a more or less distant point. If the coincidences are many, he considers it proof of borrowing.

There are various objections to this rough and ready method, notably one, to wit: that all 'elements' are not equally valuable for comparison, to which obvious fact he does not appear to attach much weight.

It is curious to note in the same number of the *Zeitschrift* that Frobenius, in discussing the prevalence of vase worship, quite positively condemns the hypothesis which is at the base of Dr. Boas' arguments. Evidently the subject is still an open question.

THE STORY OF 'NUMBER NIP.'

THE story of 'Number Nip,' the tricky wood and mountain sprite, is not unknown to English folklore, but is not prominent in it, and was introduced at a rather recent date from Germany. There, under the name Rübezahl, he figures, especially in the Riesengebirge, as a prominent personage in the tales and superstitions of the population. He has been made the subject of a singularly learned monograph lately by Dr. A. Lincke, of Dresden, who, in an octavo of fifty pages, brings together pretty much everything, at least references to it, that has been written about him.

The general conclusion appears to be that Rübezahl is no more at home in the Giant Mountains than he is in England; that perhaps he is of Slavonic origin, and that his name is a Slavonic word rendered into a German equivalent by that process of popular language which some linguists call 'otosis;' and that in this change of place and name, like many a human analogue, he left his good character behind him. Originally he was probably a divinity of the fields and crops, or vegetation and growth. Or he is a rain and thunder god of the old Germans, to which Dr. Lincke inclines; in either case, once a highly respectable god, and no mere Kobold. The title of Dr. Lincke's paper is 'Die Neuesten Rübezahlforschungen. Ein Blick in die

Werkstatt der mythologischen Wissenschaft.'

D. G. Brinton.
University of Pennsylvania.

CURRENT NOTES ON METEOROLOGY.

AUSTRALIAN METEOROLOGY.

Three valuable contributions to the meteorology of Australia have recently been published together in one volume by Hon. Ralph Abercromby, under the title *Australian Weather*. All of these papers have been previously published elsewhere, but they are now brought together and issued in book form for convenient reference. The first paper, by H. C. Russell, the Government Astronomer of New South Wales and Director of the Sydney Observatory, on *Moving Anticyclones in the Southern Hemisphere* (originally published in Quart. Journ. Roy. Met. Soc., Jan., 1893), gives a general account of the anticyclones which control Australian weather south of latitude 20° S. The average number of anticyclones which pass over the country every year is 42; they are most numerous in summer, and their average velocity is 400 miles a day. The author holds out the hope of possible long range forecasts for a month in advance, or even for longer periods.

The second paper, on *Southerly Bursters*, by H. A. Hunt, of the Sydney Observatory (originally published in Journ. Roy. Soc., N. S. W., xxviii, 1894), was awarded a prize of £25 offered by Hon. Ralph Abercromby for the best essay on southerly 'bursters.' The 'burster,' formally called the 'brick-fielder' because it was heralded by a cloud of reddish dust from the neighboring brick-fields, is a strong southerly wind associated with a V-depression, and bearing some resemblance to the 'pampero' of Brazil and the 'norther' of Texas. This is an exhaustive study of this interesting phenomenon. The last paper, also by Hunt, on *Types of Austrliana Weather*, is a clear and useful account of the typical atmospheric conditions controlling Australian weather, and is illustrated by numerous maps.

INTERNATIONAL CLOUD ATLAS.

The *International Cloud Atlas*, already referred to in these notes, may be purchased of MM. Gauthier-Villars et Fils, 55, Quai des Grands-Augustins, Paris, for 14 francs a copy. The *Atlas*, which contains 28 views, is now the official cloud atlas of the world, and the illustrations in it are the types to which all cloud forms must hereafter be referred. It is the work of the International Cloud Committee, appointed by the International Meteorological Conference held at Munich in 1891, and the standard types now adopted were selected from over 300 photographs collected from all parts of the world. The Cloud Committee is composed as follows: Hann, Hildebrandsson, Mohn, Riggenbach, Rotch and Teisserenc de Bort, and the sub-committee in charge of the publication of the *Atlas* comprises Hildebrandsson, Riggenbach and de Bort.

METEOROLOGICAL WORK AT BATAVIA.

From the 17th volume (for 1894) of the *Observations made at the Magnetical and Meteorological Observatory at Batavia*, we learn that the sub-director of the Observatory, Dr. S. Figee, is conducting an elaborate inquiry into the influence of the moon upon the magnetic elements at Batavia, some of the results of which study appear in the present volume. A large number of cloud photographs have also been taken at the Observatory, with satisfactory results, as a preparation for the work of the International Cloud Year. It is disappointing to note that it is feared the cloud observations by means of theodolites will prove to be too trying for the eyes of the observers at Batavia, and may have to be given up.

WEATHER MAP OF THE ST. LOUIS TORNADO.

THE Weather Bureau has issued what it calls a 'souvenir' weather map of the St. Louis tornado of May 27th. The sheet is of small size (8 in. by 10 in.). On one side there is a map showing the weather conditions over the United States on the evening of May 27th, with the tornado districts indicated by red crosses, and with brief descriptive text beneath. On the reverse side is an explanation of the wind, weather and temperature signals of the Bureau.

R. DEC. WARD.

HARVARD UNIVERSITY.

NOTES UPON AGRICULTURE AND HORTICULTURE, VIII.

POTATO CULTURE.

WITHIN the past month no less than six bulletins have been issued by as many Stations upon potato culture or some phase of it.

HASTENING MATURITY OF POTATOES.

'HASTENING maturity' is the sub-title of bulletin No. 36 from the Rhode Island Station. Three methods of bringing about an earlier crop are considered and one in detail, as it has been tested at the Station. Director Flagg and Mr. Tucker write: "Maturity may be hastened in three ways. (a) By planting sets in pots in a greenhouse and transplanting to open ground; (b) by sprouting, that is planting sets thickly in a cold frame, and when ready to break ground transplanting them to the field, and (c) by building." For the latter small potatoes the size of hen's eggs are given heat and light for six weeks or so before planting time, thus causing a strong bud to develop and roots to form. The budded potatoes are placed in the field with the care given to onion sets, etc. A gain of 32 bushels per acre was obtained by this method over the ordinary way of planting.

CRIMSON CLOVER GOOD FOR POTATOES.

IN Bulletin No. 38 of the Maryland Station, Director Miller and Mr. Brinkley find that crimson clover plowed under increased the yield in 1894 thirty-six and in 1895 fifty per cent. Ridge and level culture have given the same results, and also deep and shallow cultivation proved of equal value. Spraying four times with Bordeaux mixture to prevent blight doubled the crop.

POTASH FOR POTATOES.

AT the Kentucky Station (Bulletin No. 61) Director Scovell found that potash was the most profitable commercial fertilizer to use, while the nitrates and phosphates were sometimes used at a financial loss. Several tests were made to check the scab; but here is an instance in which it is a misfortune for the enemy to fail to appear anywhere in the field and the results are postponed thereby.

SCAB AND INTERNAL BROWN ROT.

PROFESSOR GREEN in Minnesota Station Bulletin No. 45 reports that the subsoiling of heavy clay land increases somewhat the yield of potatoes. Considerable space is given, with engravings, to the report upon treatment for scab. The germ theory, or fungous nature of the disease is recognized in full, for it is stated that: "Perfectly clean seed planted on land which is free from scab fungus will always and in any season produce a crop of smooth clean potatoes, no matter what the character of the land. * * * Land infected by the germs of this disease will produce a more or less scabby crop, no matter how clean and smooth the seed is." It is recommended to dig scabby potatoes as soon as ripe, because the scab continues to grow so long as the potatoes are in the ground.

The internal brown rot works at the center of the potato, and all thus infested

should be discarded as seed. The cause of this trouble is not given.

EARLY AND LATE POTATO BLIGHTS.

Bulletin 113 of the Cornell, N. Y., Station treats only of the diseases of the potato, giving several illustrations of these troubles and one coloritype plate of blight. Two leaves are shown in this, one of the 'early Blight' and the other of the 'late blight." The former is due to the fungus *Macrosporium Solani*, E. & M., and the latter to *Phytophthora infestans*, DeBy, a downy mildew which, when affecting the tubers, produces the potato rot, an old enemy in Europe, where it has caused famines, as in Ireland in 1846. Prof. Lodeman draws largely upon the literature of this blight, mentioning its rapid growth in and destruction of the attacked vines and the disagreeable odor of the ruined potatoes. The germ tube from the spore secretes a ferment that dissolves the cell wall of the host, and permits the parasite to pass through. The term 'late blight' came from the fact that the Phytophthora does not usually appear before August. The early blight comes sooner in the season, and usually the fungus follows after some injury, frequently the work of flea beetles. The earlier plantings of the same variety are the more affected by this blight.

Bordeaux is a satisfactory remedy for the late blight and a promising one for the early blight.

The cause of the scab is considered and the corrosive sublimate both highly recommended with the precaution that it be not used so strong as to injure the seed.

VARIETY TESTING OF POTATOES.

Bulletin 65 Ohio Station is devoted to the comparison of varieties of potatoes and experiments with fertilizers, by Profs. Green and McFadden. They maintain that variety trials are of much value only when the sorts are tested under several sets of conditions. It is the summing up of sets of trials that brings results of practical importance. Thus the three varieties that have averaged highest at the central and both sub-stations in Ohio are American Wonder, Columbus and Irish Daisy. Varieties that are the least influenced by variations of soil, climate, etc., they claim are the most valuable.

GOVERNMENT FARMERS' BULLETIN UPON POTATOES.

In addition to the above station bulletin the United States Department of Agriculture has issued a farmers' bulletin (No. 35) upon Potato Culture, by Mr. Duggar with the following sub-heads: Soil and rotation, manuring, varieties, planting, change of seed, side of seed pieces, distance in the row, mulching, storing, with a lengthy summary. This is a remarkably comprehensive, condensed and clear exposition of potato culture.

The impression at least is gained from the above notes that the potato is fully recognized by experimenters as a leading crop in the country and likewise a subject that is many sided and as yet far too little understood.

Byron D. Halsted.

SCIENTIFIC NOTES AND NEWS.

SIR JOSEPH PRESTWICH.

At the meeting of the Geological Society of London, on June 24th, the President, Dr. Henry Hicks, said: It is with deep regret that I have to announce to you the death of our dear and much-beloved friend, Sir Joseph Prestwich. He was elected into the Society in the year 1833, and we had come to look upon him as the father of our Society. He served it as Treasurer and President and was one of its Wollaston Medallists, and we feel that by his death our Society loses one of its truest friends. He always gave us of his best, and delighted to communicate his knowledge to his fellow workers. He was in every respect a typical representative of our Society and its objects, for he passionately loved the science, fearlessly

maintained what he believed to be the truth, and had that open mind and craving for knowledge which has ever characterized the best and noblest of its members. This is not the time to refer specially to his labors; but we may feel assured that such sterling work as he accomplished will ever hold an honored place in the annals of British geology. The Council at their sitting this afternoon passed the following resolutions, which I feel no doubt all the Fellows present will cordially endorse:

(1) That the President, Council and Fellows of the Geological Society of London desire to convey to Lady Prestwich the assurance of their heartfelt sympathy with her in the sad and irreparable loss that she has sustained, and at the same time to place on record their high appreciation of the lifelong geological work achieved by Sir Joseph Prestwich, who for sixty-three years was a member of their body, alike respected and beloved.

(2) That this Resolution be placed upon the Minutes, and a copy of it be communicated to Lady Prestwich.

The above resolutions were then passed unanimously.

'A NEW FACTOR IN EVOLUTION.'

UNDER this title Prof. J. Mark Baldwin has contributed an article to *The American Naturalist* (June and July) enlarging upon the views published by him in this JOURNAL (Aug. 23, 1895, Mar. 20, Apr. 10, 1896). Prof. Baldwin thus sums up the factors in evolution which he designates 'organic selection' and 'social heredity.'

"*Organic Selection.*—The process of ontogenetic adaptation considered as keeping single organisms alive and so securing determinate lines of variation in subsequent generations. Organic selection is, therefore, a general principle of development which is a direct substitute for the Lamarkian factor in most, if not in all instances. If it is really a new factor, then it deserves a new name, however contracted its sphere of application may finally turn out to be. The use of the word 'organic' in the phrase was suggested from the fact that the organism itself cooperates in the formation of the adaptations which are effected, and also from the fact that, in the results, the organism is itself selected; since those organisms which do not secure the adaptations fall by the principle of natural selection. And the word 'selection' used in the phrase is appropriate for just the same two reasons.

"*Social Heredity.*—The acquisition of functions from the social environment, also considered as a method of determining phylogenetic variations. It is a form of organic selection, but it deserves a special name because of its special way of operation. It is really heredity, since it influences the direction of phylogenetic variation by keeping socially adaptive creatures alive, while others which do not adapt themselves in this way are cut off. It is also heredity since it is a continuous influence from generation to generation. Animals may be kept alive, let us say, in a given environment by social cooperation only; these transmit this social type of variation to posterity; *thus social adaptation sets the direction of physical phylogeny and physical heredity is determined in part by this factor.* Furthermore, the process is all the while, from generation to generation, aided by the continuous chain of extra-organic or purely social transmissions. Here are adequate reasons for marking off this influence with a name."

GENERAL.

THE Astronomer Royal, Mr. Christie, has been unanimously elected corresponding member of the Paris Academy of Sciences in the place of the late Mr. Hind.

ADVICES from Japan state that the two American expeditions to observe the solar eclipse under the charge of Professors Todd and Schæberle, respectively, have reached Yokohama.

THE sum of $5,000 has been subscribed for the purpose of erecting a statue as a memorial to the late Wilhelm Mayer, of Copenhagen, the discoverer of adenoid vegetation of the pharynx. It appears that the largest sum has been subscribed in America (about $1,500), Great Britain and Denmark each having subscribed in the neighborhood of $1,200 and Germany $500.

MRS. HUXLEY, widow of Prof. T. H. Huxley, has been granted a Civil List pension of £200 a year.

AT the celebration of the centennial of the founding of the city of Cleveland, it was an-

nounced that Mr. John D. Rockefeller would give the city for a park 276 acres of land valued at more than $600,000.

THE *Hauer Medaille*, of the Vienna Geographical Society, and the gold *Kirchenpauer Medaille*, of the Geographical Society of Hanover, have been awarded to Prof. Neumayer, of Hamburg.

THE Ashmolean Museum, Oxford, was struck by lightning on July 7th. The fire was extinguished before damage was done to the valuable contents of the museum. There are four lightning conductors on thé building, but the electric current struck a gable on which there was no conductor and traveled along a lead gutter and down a standpipe to the earth.

THE completed building of the Indian Institute at Oxford was declared open on July 1st by Lord George Hamilton, the Secretary of State for India. The building contains an oriental library and museum.

MR. PERCIVAL LOWELL, of Boston, has left for Flagstaff, Arizona, to continue observations on the planet Mars. He is accompanied by Mr. Alvan G. Clark, who will mount the new 24-inch telescope. Dr. T. J. J. See, of the University of Chicago, also accompanies the expedition in order to continue his observations on double stars.

PROF. G. D. HARRIS, of Cornell University, is spending the summer in Alabama, making paleontological collections for the University.

THE death is announced of Prof. A. G. Stoletow, professor of physics in the University of Moscow.

A LIFE of Fridtjof Nansen by W. C. Brögger and Nordhal Rolfsen has been published in Scandinavia.

PROF. HUGH C. MCLAUGHLIN died on July 20th at the age of 85. He had recently been a professor of classical languages and had formerly been Superintendent of the Bureau of Statistics.

THE daily papers state that Mr. William R. Brooks, director of Smith Observatory, while observing the moon recently with the large telescope, made a most interesting and unique discovery. A dark round object was seen to pass rather slowly across the moon in a horizontal direction. Mr. Brooks believes that it was the passage of a dark meteor between the earth and the moon, far beyond the earth's atmosphere, so that it remained non-luminous.

A NEW entomological journal, *Illustrierte Wochenschrift für Entomologie*, will hereafter be published by Neumann in Neudamm. It proposes to treat rather the biological relations of insects than systematic entomology.

THE *Scientific African*, a journal founded at the beginning of the present year in South Africa, has been compelled to suspend publication.

THE discontinuance of the publication *Climate and Health* is announced to take effect with the end of the present fiscal year, June 30, 1896. Vol. II., No. 3 (four weeks ended March 28, 1896), will be the last issue. It has been deemed necessary to take this action in view of a doubt having arisen as to whether the publication of *Climate and Health* was authorized by the act making appropriation for the Department of Agriculture for the fiscal year ending June 30, 1897. It is the intention of the Chief of the Bureau to have prosecuted during the coming fiscal year a number of special climatologic studies, and it is expected that the statistics collected during the present fiscal year will be of much value in this connection. The results of these special researches will, if their importance justifies it, be published in the form of special bulletins, at such times and in such shapes as the circumstances may warrant.

WE have received the first number of *The Laryngoscope*, a new monthly journal devoted to diseases of the nose, throat and ear, edited by Drs. F. M. Rumbold and M. A. Goldstein. The number opens with an article by Dr. S. Montbleyer on the Photo-Fluoroscope, describing applications of the X-Rays in laryngology.

PSYCHICAL research has assumed such dimensions that Mr. W. H. Myers finds it desirable to compile a glossary in the June number of the *Proceedings of the Society*. Many of the terms given are those commonly used in psychology and medicine, but we owe to Mr. Myers the invention, or at least wide application, of the words 'telepathy' and 'subliminal,' and we

find here a number of other words suggested by him—'cosmopathic,' 'hyperpromethia,' 'methectic,' 'telergy,' etc., which we may not only soon find in the Century Dictionary, but may also hear on the street corners some day.

DR. LÉON BERTRAND, of Antwerp, describes in the *Medical Record* a fluoroscope in which double fluoride of uranyl and ammonium was used as the fluorescent substance. This is said to be fully as good as other substances, such as tungstate of calcium and to be much cheaper.

ON July 4th the Royal Societies' Club gave a complimentary dinner and reception to the newly elected Fellows of the Royal Society and the newly elected Royal Academicians and Academicians-elect. Speeches were made by Sir Clements Markham, Sir Robert Ball, Prof. Ray Lankester and others.

The Railway Review describes a foul-air indicator exhibited at the Industrial Exposition at Zurich, Switzerland, which is designed to show whether and in what degree the air in a workshop or other inhabited room is contaminated. The apparatus is described as consisting of an air-tight closed glass vessel filled with a red fluid. Through a glass tube that dips into the liquid and is bent at the top a drop falls every 100 seconds on a cord that hangs beneath and that is somewhat stretched by a weight. The fluid from which the drop comes has the property of changing its color by the action of carbonic acid. The more carbonic acid there is in the air the quicker this change in color takes place. If the air is very foul the drop becomes white at the upper end of the cord, while the change of color corresponding to a slight proportion of carbonic acid does not take place till the drop has run further along the cord. The exact condition of the air can be ascertained by observing a scale that is placed alongside the cord and divided into convenient parts, bearing the designations, 'extremely bad,' 'very bad,' 'passable,' 'pure.'

MM. BEAUREGARD and Dupuy have reported to the Paris Academy, experiments on electrical variation in the acoustic nerve when excited by a sound with one electrode placed on the tympanum and one on the nerve it was possible to note the variation of the current with the pitch of the sound which gives a method for determining the range of audibility for pitch in the lower animals.

UNIVERSITY AND EDUCATIONAL NEWS.

THE FUTURE OF AMERICAN COLLEGES AND UNIVERSITIES.

IN the *Atlantic Monthly* for August President Gilman takes the appearance of the memoirs of Barnard and McCosh as an occasion to review the progress and outlook of universities in America. President Gilman's article is of special interest, as he not only writes from wide knowledge, but also with the power to carry into effect the ideas that he advocates. He says: "Barnard came very near the right expression when he claimed that the university must be 'a school of all learning that the necessities of the age demand.' Whatever may be the best definition of a university, its functions are clearly to be discovered. It must above all things be a seat of learning, where the most cultivated scholars reside, where libraries, laboratories, and scientific collections are liberally kept up, and where the spirit of inquiry and investigation is perpetually manifested. It must be a shrine to which the outside world will resort for instruction and guidance upon the problems of the day, scientific, literary, educational, political. It must be a place from which are sent forth important contributions to science—theses, memoirs, books. Here every form of scientific investigation should be promoted. Researches too costly for ordinary purses should be prosecuted at the expense of the general chest. Expeditions should be sent forth from time to time to engage in investigations on the seashore or on the mountains. Physical and astronomical instruments of the most improved forms should be devised, procured and frequently renewed. The literatures of all nations, ancient and modern, should have their devotees. Every school of philosophy should be interpreted. Historical and political inquiry should be diligently promoted. The problems of modern society, economical, industrial, financial, administrative, philan-

thropic, demand the most careful examination. All these researches should go forward in an atmosphere of repose and leisure, very different from that of business and professional engagements.''

GENERAL.

The *Ithaca Daily Journal* states that there are 179 students enrolled in the Cornell University summer school, exclusive of 40 students in the school of law. A large part of the students—58 per cent.—come from states other than New York.

During the last ten years the department of entomology of Cornell University has deferred the regular winter term's work until summer. These summer terms have been largely attended, and by many who are now holding professorships in other colleges or at experiment stations. The present summer term is attended by 18 students, 6 of whom are graduates, and a part of the graduates are professors of entomology in other colleges. Certainly, if insect life and the economic side of entomology are to receive due consideration, this plan of a summer instead of a winter term commends itself. There is also the advantage of not being disturbed by the demands of other subjects. It also makes more advanced work possible.

Dr. Thaddeus L. Bolton, of the faculty of the State Normal School at Worcester, has resigned to accept a position in the State Normal School at San José, Cal., at the head of the department of psychology, pedagogy and training of teachers.

Dr. Vaughan Harley has been appointed to a newly established professorship of pathological chemistry in University College, London.

Prof. Paul Jacobson has been called to Berlin to fill the position of General Secretary of the German Chemical Society.

Drs. Josse and Kämmerer have been appointed full professors of engineering in the Technical High School of Berlin, and Prof. Schmidt, of Stuttgart, has been made director of the Weather Bureau at Würtemburg in the place of Prof. Mack, who has retired.

Garden and Forest states that the first horticultural school for women in Germany was opened at Friedenau, near Berlin, in the autumn of 1894, and it will graduate its first class of seven members next fall. One of the graduates will then assume the position of teacher in a similar school recently established at Riga, in Livonia. On the first of October next still another institution of the kind will be opened on the estate of Baroness Barth-Harmating, near Plauen, in Saxony. The courses of study extend over two or three years, and include not only the various branches of horticulture, but also fundamental scientific instruction and such knowledge of business methods as is needed for the successful prosecution of commercial gardening. Emphasis is laid upon the fact that the new work thus made possible for women is suitable for those of the cultivated classes, and not for uneducated or semi-educated rustics.

The Duke of Devonshire has introduced in the House of Lords a bill, somewhat similar to that introduced by Lord Playfair in the last Parliament, consolidating the educational institutions of London with a view to the establishment of a great university. The report of the Cowper Commission has thus the support of the two English parties, but it is not likely that any progress will be made during the present session of Parliament.

The issue of *Nature* for July 9th contains an extended article discussing the position of science at Oxford, which takes a somewhat discouraged view of the place of science in the University. It attributes the comparatively small number of students in the school of natural science in part to the lack of scientific instruction in the public schools, which is in turn due to the nature of the examinations required for entrance to the University, and in part to the fact that there are only three science tutors in all the colleges, while the course chosen by the student depends largely on the advice of his tutor.

DISCUSSION AND CORRESPONDENCE.

THE TEACHING OF ANATOMY.

To the Editor of Science: It seems to me proper to take some exception to Prof. Mall's paper on this subject, which you quote from in

the issue of July 10th, for there are many points connected with this question of great practical interest. I assume that Prof. Mall is speaking of teaching anatomy to medical students. If I am mistaken as to this, I have nothing but praise for his methods; but if he is speaking of medical education it seems to me that he puts himself out of court at once. He says: "The object of the laboratory is to teach students, to train investigators and to investigate. Although the first mentioned requires the greater portion of the instructor's time; its importance is by no means as great as the second and third." I submit that the first and most important duty of a professor in a medical school is to teach the students his branch in the manner best fitted to their future needs as practitioners of medicine. He must find time for scientific research when he can, and it must be subordinate to his teaching, and to his teaching for a practical purpose. Prof. Mall is very severe on the lecture system. He mentions that several professors, 'even' of anatomy, declare that they learned nothing that way. I wish my name to be added to the list; but I conceive the reason to be that I had no lectures worth listening to. It seems to me that there is a fallacy in calling the method stupid because none of us would choose it for himself were he a student. Of course, we would choose to be the private students of some distinguished anatomist; but this is impossible for all the members of a large class. Moreover, as implied above, we professors of anatomy are hardly fair representatives of the rank and file of medical students, who are studying anatomy as a means and not as an end. Again, I am not sure precisely what is meant by 'lectures,' as Prof. Mall admits that 'lectures with demonstrations are certainly valuable—more valuable than the lectures with text-books alone.' But who does lecture with a text-book? It is true that I have heard of a professor of anatomy who gave his class a certain number of pages of Gray learned by heart; but what competent man does not illustrate his lectures to the best of his ability? It is his duty to emphasize certain parts of his subject and to go lightly over others, to point out the practical deductions, to show what facts are for, what against, prevailing theories. If lectures are to be abolished the professor might be abolished too were it not necessary for him to lay out the course and to see it carried out. In a large school the teaching or guiding of small groups must of necessity be left to assistants of varying learning and of varying power of imparting it, and were there no lectures the professor's influence would be lost. There must be students of all grades, and to my mind those who learn the most from the lectures are the best ones. The worst are hopeless anyway; probably a little more so in the laboratory course that they neither understand nor appreciate.

But, though I firmly believe in the anatomical lecture, I believe in personal study, in demonstration to small classes, and in close supervision. I am developing these at Harvard as fast as I can. Prof. Mall's plan strikes me as most admirable for the training of scientists; I do not believe in it even for good medical students; certainly I do not want to have it implied that those who differ are behind the times in matters of medical education.

THOMAS DWIGHT.

HARVARD MEDICAL SCHOOL.

IS NOT THIS COUNTRY RIPE ENOUGH TO ADOPT THE METRIC SYSTEM?

ON reading in your issue of July 17, Prof. Slosson's clear and cogent exhibition of the present condition of Decimal Numeration in the United States, I am impressed by the rapidity with which a great change in the habits of thought of our people has been brought about. The paramount influence of the custom of reckoning in dollars and cents is palpable; it first became universal on the disappearance from circulation of the Spanish fractional coins which were common during the first half of this century. But beside that it is evident that the change of usage from 'common' fractions to decimals has been due in some measure to the improved general character of the school arithmetics, faulty enough though many of these books may still be. The change bears emphatic witness to the efficacy of scientific methods of teaching and to the good results which must necessarily follow from the action and reaction

of scientific methods in the class room upon the affairs of every-day life. Barring the risk of some vicious compromise, it should be a hopeful sign for the speedy adoption of the metric system that the American people are now so thoroughly imbued with the decimal method of notation and have become impatient of other forms of reckoning.

As bearing on the difficulties felt to-day by several eminent Englishmen, I can testify that thirty years ago when serving in a great manufacturing establishment under a man of more than ordinary ability and intelligence, who had been thoroughly drilled in the intricacies of the older arithmetics, it was a matter of surprise to us youngsters that on presenting any decimal computation to our chief he invariably converted the decimals into vulgar fractions, not at all for the sake of the double verification of our work, but that he might comprehend clearly the matter in hand. We respected the thoroughness with which the old schooling had taken possession of the man, though we could not but marvel that the number of his fingers and toes had so little influenced the workings of his mind. I have reason to believe that many elderly merchants and manufacturers in this vicinity were at that time of the same habit and opinion as my friend; in fact, their training had been similar to his. But it would probably be difficult to find many such men in the country to-day.

It may seem incredible to most of your readers, as it does to myself, that the per cent. mark (%), now in universal use, is in this country a modern innovation. In the year 1858, on the occasion of printing a 'Dictionary of Solubilities,' I found that the charater % was unknown to the printers and type founders of Boston and Cambridge, and was not to be had in the market. At my instigation, and at my own expense, the leading type founder in Boston prepared at that time a punch and matrix and cast types of the character in question. It is of interest to remark, by the way, that the procuring of this type was the result of French influence. In my capacity of American *collaborateur* of the old *Répertoire de Chimie Appliquée*, I had become familiar with the economy and convenience of the per cent. mark.

As regards the inconvenience of changing from the present to the metric system, it seems to me that it would be felt more keenly in measurements relating to buildings than in the matter of weights or of measures of capacity. Most existing constructions have been made in terms of feet and inches. 'Dimension work' and 'dimension lumber,' all joists and beams, whether of wood or iron, bricks, boards, castings and moulds for castings, are measured by feet and inches. Plans and specifications have been drawn, stated and acted upon in these terms. Feet and inches have full possession of the bodies and souls of masons, carpenters and other mechanics, and it would doubtless be highly inconvenient in many instances, especially in the case of repairs and reconstructions, to make the inch and the centimeter lie down together harmoniously.

Here is an impediment which must be faced, and the public needs to be taught how much more rational it would be to accept the metric system in its entirety than to acquiesce in the gradual subdivision of our common measures into tenths, for the sake of a simplification which would be incomplete at the best. The practical experience of the French and other nations has shown emphatically that the difficulty just now mentioned is in no sense insuperable. Every instructed person knows that the inconveniences incidental to the adoption of the system have been met and overcome by most of the civilized nations. That some small hitches may have occurred in respect to non-essential details does not in the least detract from the great gain which has everywhere resulted from the adoption of the metric system. For example, it is simply amusing to hear the hawkers in the streets of Paris offer their *haricots verts* at so many *sous* the *demi*-kilo. The habit shows merely how, in the final shadings, strict verbal and logical accuracy must give way to a combination of inherited instinct or sentiment and practical convenience. There is no sense anyway or anywhere in stickling too strongly for *le pied de la lettre*, though for the sake of preventing fraud it was, perhaps, well enough for the French authorities to have accepted the term demi-kilogram rather than to have encouraged the perpetuation of the old

word, *livre*. In respect to this country, however, there may be danger, as Prof. Slosson intimates, that we may after all drift into a less satisfactory system than the metric, in case the adoption of the latter should be too long delayed.

At the present moment we are really in some sort in the predicament of the boy blubbering at the street corner, who explained to the sympathetic stranger that his hands were so cold that he couldn't put on his mittens because it would 'hurt.' It would have been false and futile to have told the urchin that his hands were not cold or that the enterprise he shrank from could bring no pain, but it might have been well to convince him that he was a baby, and to have suggested ways and means of taking the leap with the least possible inconvenience.

F. H. STORER.

SCIENTIFIC LITERATURE.

Preliminary Synopsis of the American Bears. By DR. C. HART MERRIAM. Proc. Biol. Soc. Washington, X., 1896, pp. 65–83, pll. iv–vi. April 13, 1896.

Material for the comparative study of any of the larger mammals is exceedingly troublesome to bring together in satisfactory amount, owing to its bulky character and the labor and expense of its preparation and transportation. This is particularly the case with our North American bears, where the large series of specimens, skins as well as skulls, necessary for their detailed study, is especially difficult to acquire. By the expenditure of much time and labor Dr. Merriam has been able to gather for the present investigation about 200 skulls, but, owing to the lack of proper material, has been unable to treat of the external characters of the species and sub-species he believes are entitled to recognition. In fact, of several of the forms here for the first time recognized no skins exist in any of our museums. We, hence, have here merely a preliminary announcement of the results of a study of the cranial and dental characters, which is 'to be followed later by a more comprehensive treatise.' This preliminary announcement, however, is most welcome, since it has been for some time evident that the number of forms of North American bears is much greater than has been currently recognized.

As all are aware who have made a study of bears, the range of individual variation, in cranial as well as in external characters, is quite extended, in addition to which there is much variation due to age and sex. This Dr. Merriam duly concedes, and still finds, after making allowance for such differences, characters that appear to be constant, by which the species and sub-species may be recognized. In view of what is now known of the variability, with varying conditions of environment, of the smaller North American mammals, it is not surprising that Dr. Merriam has found it necessary to recognize a considerable number of new forms. Whether their status will be that of full species or in some cases that of sub-species merely, it is evidently too early to determine. Of the eleven species here formally admitted, five are described as new, and two additional sub-species are incidentally indicated as probably worthy of recognition.

Heretofore it has been customary to refer the bears of North America to three groups, consisting of the polar bear type, the grizzly bear type and the black bear type. To these Dr. Merriam adds the Sitka bear type and the Kadiak bear type. The polar bear was long since separated from the land bears as *Tholarctos maritimus* (Linn.), and remains thus far a monotypic group. The black bears were also some time since distinguished as a separate sub-genus (*Euarctos* Gray) of the genus *Ursus*, in which latter genus all the other North American bears are still retained.

Dr. Merriam considers that "the black bears may be separated into at least four species, having more or less circumscribed geographic ranges." He recognized of the grizzly bear group also four more or less marked forms. As distinct from the grizzlies, Dr. Merriam distinguishes, as already said, two other types of large bears, one of which consists of two species and the other of one, the *Ursus middendorffi*, 'the largest of living bears,' and 'differing markedly from the other American species.'

The species and sub-species recognized in this important paper are the following:

1. Polar Bear, *Thalarctos maritimus* Linn.

2. Kadiak Bear, *Ursus middendorffi* Merriam, of Kadiak and the Alaskan Peninsula.

3. Yakutat Bear *Ursus dalli* Merriam, from Yakutat Bay, Alaska.

4. Sitka Bear, *Ursus sitkensis* Merriam, from Sitka.

5. Grizzly Bear, *Ursus horribilis* Ord.

6. Alaska Grizzly, *Ursus horribilis alascensis* Merriam (nom. prob.).

7. Sonora Grizzly, *Ursus horribilis horriæus* Baird.

8. California Grizzly, *Ursus horribilis californicus* Merriam (nom. prob.).

9. Barren Ground Bear, *Ursus richardsoni* Reid.

10. Black Bear, *Ursus* (*Euarctos*) *americanus* Pallas.

11. Louisiana Bear, *Ursus* (*Euarctos*) *luteolus* Griffith.

12. Everglade Bear, *Ursus* (*Euarctos*) *floridanus* Merriam.

13. Glacier Bear *Ursus* (*Euarctos*) *emmonsi* Dall, St. Elias Alps, Alaska.

The paper is very fully illustrated, having seventeen cuts in the text and three plates, illustrating the dental and cranial characters of the forms recognized. Many of the figures of the skulls are reproductions from photographs.

J. A. A.

Elementarcurs der Zootomie in fünfzehn Vorlesungen. Von Dr. B. Hatschek und Dr. C. J. Cori. Jena, Gustav Fischer. 1896.

This new zootomy of viii. and 104 octavo pages, 18 plates and 4 text figures comes to us as a surprise after waiting so long (and apparently in vain) for the Vierte Lieferung of Hatschek's Lehrbuch der Zoologie. It devotes four lectures to Salamandra maculosa, one to Rana temporaria, two to Anodonta mutabilis, two to Helix pomatia, two to Astacus fluviatilis, two to Periplaneta orientalis, one to Lumbricus terrestris, and one to Hirudo medicinalis. Apus cancriformis and Hydrophilus piceus each constitutes an 'Anhang' to the eleventh and thirteenth lecture respectively. Of the plates four are devoted to the Salamander, one to Rana, two to Anodonta, two to Helix, three to Astacus, one to Apus, three to Periplaneta and Hydrophilus, one to Lumbricus and one to Hirudo.

The general plan of the book is to indicate first in a table or two the systematic position of the animal to be studied; then, as an introduction, give a brief account of the organization and relationship of the group to which the animal belongs, and then give an account of the external and the internal anatomy of the animal, preceding the accounts of the several systems of organs with brief laboratory directions. Practically it is a meager laboratory guide distributed in a text-book that aims to give the beginner a general survey of the animal kingdom in as short a time as possible, and with material most easily obtained at Prague.

The fish is omitted because a profitable study would require too much time, and the Coelenterata, Echinodermata and Ascidians are merely alluded to in the lectures, because laboratory work on these groups is impracticable in 'eines ganz elementaren Kurses.' When we read the lectures, the technical notes and examine the figures we exclaim what is a 'ganz elementar Kursus' at a university!

In the preface we are told this elementary course in zootomy is the outcome of a ten-years' experience at the University at Prague and that with respect to 'Form, Inhalt und Ausdehnung' it represents quite accurately the annual course of lectures and exercises given at the University. The object of the course, it is stated, is to acquaint the beginner with a mass of facts that in connection with the lectures upon theoretical zoology shall constitute a foundation for more advanced study.

All of this we are assured can be attained in fifteen two-hour periods! This will no doubt be welcome news to the lovers of the '14 weeks' courses which many of us mention with so much respect. Personally we have no time to waste upon such courses at our colleges or universities, and we even have our doubts as to their value in our high schools.

It is the unanimous verdict of careful observers that the American student in general is not a whit inferior to the German student, and yet these authors would have us believe their beginners in zoology study 'in fruchtbringender Weise' the vascular and nervous systems of Salamandra maculosa—listening to the lecture, dissecting and making sketches and notes of

these systems—in two hours! And this at the beginning of the course! This same course also provides laboratory work on Apus and Hydrophilus in addition to that on two other Arthropods, but can not get time for any work on the fish or the Echinodermata or the Coelenterata. We can crowd ourselves enough to pass the Tunicata, but we can hardly comprehend how a man capable of beginning so promising a work as the 'Lehrbuch der Zoologie' can so lightly pass over these magnificent groups.

As to the figures we are bound to say that in point of distinctness most of them are inferior to those of well known standard works. The shading is often poorly done, though they are all neat and clean. Originality, however, is hardly enough to justify a new figure, particularly if it is to appear in a text-book for some good. Unless a figure is a decided improvement in some respect or other we prefer to have it remain the exclusive property of the author and his students. Some of the figures are of necessity so much like well known old ones that they have nothing to specially recommend them.

It is undoubtedly a mistake to introduce into an elementary course individual views of matters in dispute. The authors have not sinned grossly in this respect; still the 'Cladus' and 'Anhang' ideas might have been kept out without impairing the value of the book. We even get the accounts of Apus and Hydrophilus as Anhänge.

The hope of the authors that their 'Büchlein' will prove useful to others may be realized to some extent in Germany; but for the English teacher and student, excepting the descriptions and illustrations of animals not taken up so fully in other books, there is nothing in it to recommend it above any of the good books now available. HENRY F. NACHTRIEB.

SCIENTIFIC JOURNALS.

THE PHYSICAL REVIEW, JULY–AUGUST.

On the Measurement of the Expansion of Metals by the Interferential Method: By E. W. MORLEY and WM. A. ROGERS. The first part of this article by Prof. Morley is devoted to a description of the method used, which consists essentially in measuring the change in length, during the heating or cooling of a test bar, by observing the displacement of interference bands. These bands result from the interference of beams of monochromatic light reflected from mirrors which are placed at the ends of the test bar and a constant temperature bar respectively. A later article will contain the results of an actual trial of the method. As in all cases where interference phenomena are used, the method demands great care in all details and is capable of extreme accuracy. Prof. Morley discusses the sources of error and the means of avoiding them at some length and in a very practical manner. A difficulty which one would not be apt to think of arose when the sodium flame was used as a source of light; for the number of bands to be counted was so great (five or six thousand) that the slight difference in wave-length between the two sodium lines caused a great decrease in the visibility of the bands in certain regions. Thus when about 3,400 bands had been counted, the fringes were so obscure that the next hundred could hardly be observed at all.

The Viscosity of Polarized Dielectrics: By A. W. DUFF. Professor Duff finds that the viscosity of certain non-conducting liquids, such as glycerine and castor oil, is increased when the liquid is subjected to considerable electrostatic stress. The increase observed was small, being expressed in fractions of one per cent., but the fact of its existence seems to be definitely proved. The change was measured by observing the rate of descent of small spheres which were allowed to fall through the liquid between two oppositely charged plates. If, as seems probable, Prof. Duff's results are confirmed, we have here a new class of electrical phenomena, doubtless intimately connected with the electrostatic Kerr effect.

Note on the Theorem of Clausius: By EDGAR BUCKINGHAM. Prof. Buckingham's object is to give a demonstration of what we usually refer to as the 'Second Law of Thermodynamics,' for cases not considered in Clausius' original proof and usually treated very briefly by his followers. The cases considered are (1) systems whose state is defined by only one coordinate besides the

temperature, but where the work done is not necessarily confined to overcoming pressure. The coordinate used to define the state may be of the most general type; *e. g.*, quantity of electricity, as used by Helmholtz. (2) Systems whose state is defined by more than two coordinates. An example of such a case would be an electrolytic cell in which the effect of pressure is not negligible. Professor Buckingham's article gives an interesting discussion of the graphical, as well as the analytical, treatment of such cases. The article is one which will do good, for the subject is one which must be presented in many different forms, as well as with great clearness, if our text-books are to be freed from the hazy and unsound treatments of Thermodynamics with which they now abound.

The Refractive Index and Reflecting Power of Water and Alcohol for Electric Waves: By A. D. Cole. In preliminary work the index of refraction for waves 260 cm. long was found to be 8.95 for water and 5.24 for alcohol. These results are in fair agreement with values obtained by other observers, as well as with the values computed according to Maxwell's theory from the dielectric constants. Using much shorter waves (5 cm.) Prof. Cole then again determined the indices, the object being to find at what wave-length dispersion begins. The absorption of both liquids was so great that a prism method could not be used, even with the delicate means at hand for detecting and measuring the waves. The method finally adopted depended upon the measurement of the *reflecting power* of the two liquids. The index was then computed by Fresnel's formula. The values obtained were 8.85 for water and 3.2 for alcohol. It thus appears that there is considerable dispersion by alcohol between the wave-lengths 260 and 5 cm.

A New Electrolytic Generator for Oxygen and Hydrogen: By W. S. Franklin.

An Apparatus for Illustrating the Laws of Falling Bodies: By H. M. Randall and W. A. Markey.

Books reviewed: Gray and Mathews, *Bessel Functions;* Groth, *Physikalische Krystallographie;* Jahn, *Grundriss der Thermochemie;* Preston, *Light.*

SOCIETIES AND ACADEMIES.

NORTH CAROLINA SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The second meeting of the North Carolina Section of the American Chemical Society was held in Chapel Hill, N. C., on July 7, 1896. The Secretary reported ten new members as received since the last meeting. After the transaction of some routine business the following papers were read: 'Crystallized Aluminium,' by F. P. Venable; 'The Detection and Purification of Saccharin,' by B. W. Kilgore; 'Reduction of Sulphuric Acid,' by C. Baskerville; 'A Comparison in Digestibility of Raw and Steamed Cotton Seed,' by J. A. Bizzell and A. H. Prince; 'An Attempt to Form Some Organic Compounds of Zirconium,' by Thos. Clarke; 'The Determination of Sulphur in the Presence of Iron,' by W. A. Withers and R. G. Mewborne; 'The Action of Phosphorus Trichloride upon an Ethereal Solution of Hydrogen Dioxide,' by W. A. Withers and G. S. Fraps; 'Some Difficulties in the Way of the Periodic Law,' by F. P. Venable. The Section then adjourned to meet in Raleigh next winter. The Section has doubled its numbers in less than six months.

NEW BOOKS.

Herbart's A B C of Sense—Perception and Minor Pedagogical Works. Translated with Introduction, Notes and Commentary, by William J. Eckoff. New York, D. Appleton & Co. 1896. Pp. xviii+288. $1.50.

Grundriss einer exacten Schöpfungsgeschichte. By Hermann Habenicht. Wien, Pest, Leipzig, A. Hartleben. Pp. viii+135. Plates vii.

Tenth Report of the New York State Entomologist, for the year 1894. J. A. Lintner. Albany, University of the State of New York. 1895. Pp. 341–633.

Manual of Midwifery. W. E. Fothergill. New York and London, Macmillan & Co. 1896. Pp. xiiii+484. $2.25.

The Monetary and Banking Problem. Logan G. McPherson. New York, D. Appleton & Co. 1896. Pp. iv+135. $1.00.